

REMARKS

Claims 1-11, 14-15, 24 and 26-83 are now pending in the application, of which claims 1, 40, 47, 50, 56 and 66 are being amended and claims 79-83 are being added.

Applicant requests entry of these amendments which are fully supported by the specification and original claims and add no new matter. For example, the language "flow direction of a majority of effluent flowing past the projections or recesses away from a general flow direction of the effluent through the exhaust tube," as recited in claim 1, is supported by the specification at least on page 11, lines 9-15, which teach an exemplary general flow direction of the effluent through the exhaust tube that is "along the longitudinal axial direction of the tube." This section also teaches that "in a preferred version, the exhaust tube ... is substantially absent or free of projections or recesses that alter the effluent flow path" Figure 2 further demonstrates an exemplary embodiment of the exhaust tube, in which the tube is clearly substantially absent projections or recesses that alter the flow direction of a majority of the effluent away from a general flow direction.

The specification is also being amended to correct errors detected by Applicants and to secure correspondence between the claims and the specification as required by 37 CFR 1.117.

Reconsideration of the present case in view of the amendments and remarks herein is earnestly requested.

Allowed Claims

Applicant appreciates the Examiner's indication of allowance of claims 10, 11, 14, 15, 24, 26-30, 33-36, 40-73, and 75-78.

Rejections Under 35 U.S.C 102(b) of Claims 1, 2, 6, 9 and 31

The Examiner rejected claims 1, 2, 6, 9 and 31 under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,137,701 to Randall S. Mundt. This rejection is traversed.

Claim 1 is not anticipated by Mundt because Mundt does not disclose each and every positively set forth element in the claims. For example, Mundt does not teach or suggest an "exhaust tube being substantially absent projections or recesses that alter the flow direction of a majority of effluent flowing past the projections or recesses away from a general flow direction of the effluent through the exhaust tube," as recited in claim 1. In contrast, Mundt discloses a reaction chamber (18) comprising projections that are taught to alter the flow direction of a majority of the effluent flowing past the projections (see column 3 line 49 through column 4 line 11). For example, Mundt discloses a baffle member (60) positioned in the interior of the reaction chamber (18) and a tube (80) inserted axially into the reaction chamber (18) that serve as projections to redirect the flow of a majority of the effluent away from a general flow direction of the effluent. Mundt describes the altered gas flow in column 7, beginning at line 9. As stated by Mundt: "baffle member 60 and tube 80 force gas to flow inwardly from inlet 26, longitudinally through an annular passageway 68 between tube 80 and baffle member 60 and back through an annular passageway 63 between the baffle member 60 and the sidewall 56 before exiting through the outlet 28." Therefore, Mundt clearly has projections that alter the direction of a majority of the effluent flowing past the projections away from a general flow direction of the effluent through the tube. Thus, claim 1 and the claims depending therefrom are not anticipated by Mundt.

Rejections Under 35 U.S.C. 103(a) of Claims 3-5, 8 and 32

The Examiner also rejected claims 3-5, 8 and 32 under 35 U.S.C. 103(a) as being unpatentable over Mundt and in view of U.S. Patent 4,735,633 to Kin-Chung Chiu. This rejection is traversed.

Mundt and Chiu do not render claims 3-5, 8 and 32 unpatentable. Claims 3-5, 8, and 32 depend from claim 1. As discussed above, claim 1 recites an exhaust tube that is "substantially absent projections or recesses that alter the flow direction of a majority of effluent flowing past the projections or recesses away from a general flow direction of the effluent through the exhaust tube." Mundt discloses an exhaust tube having projections that alter the flow direction of a majority of effluent, as discussed above. Chiu does not make up for the deficiencies of Mundt or teach the removal of the projections in Mundt's device. In fact, Chiu also teaches a projection into the exhaust tube that is a spiral electrode that alters and redirects the flow of a majority of the effluent away from a general flow direction of the effluent through the exhaust. Chiu teaches against the absence of projections into the exhaust tube by teaching that it is desirable that "The gas flow will generally distribute around the spiral flow paths ... In addition to the spiral flow established by the spiral electrodes, there will be cross-flow established through gaps 32 ... such cross-flow helps establish uniform distribution of the effluent gas throughout the reaction chamber" (column 6, line 68 through column 7, line 9). The other embodiments taught by Chiu, namely the stacked electrodes 60, 62 and the plurality of concentric rings of upper and lower electrodes 102, 104, as shown in Figures 3 and 5, also alter the flow direction of a majority of the effluent, into a spiral or circular flow path, respectively (see column 7 lines 33-36).

Thus neither Mundt nor Chiu teach or suggest claim 1 and since claims 3-5, 8 and 32 include all of the limitations of claim 1, these claims also distinguish over the proposed combination of references. Therefore, the 35 USC 103(a) rejection of claims 3-5, 8 and 32 should be reversed.

Response to Examiner's Arguments

Contrary to the Examiner's argument, Applicants respectfully submit that the "projections or recesses" as claimed in claim 1, and as taught by the specification, are not limited to merely "surficial discontinuities" or "surface roughness." The section of the specification that is relied upon by the Examiner contains a compound sentence which

originally read "in a preferred version, the exhaust tube comprises a cylinder having an internal flow surface that is parallel to the direction of the flow of the effluent through the exhaust tube, and that is substantially absent or free of projections or recesses that alter the effluent flow path or provide a non-laminar flow of effluent." In other words, this sentence teaches that the exhaust tube comprises a cylinder having an internal flow surface, and also teaches that the exhaust tube may be substantially absent or free of projections or recesses. Applicants are also amending this sentence under 37 CFR 1.117 to clarify these teachings.

Objections to Claims 7, 37-39 and 74

The examiner objected to claims 7, 37-39 and 74 as being dependent upon a rejected claim.

Claims 7, 37-39 and 74 depend from claim 1 and are allowable for at least the same reasons, discussed above, as claim 1.

Added Claims

Claims 79-83 are being added with the present amendment, and are also believed to be allowable over the cited references.

The Examiner objected to claim 74 as being dependent upon a rejected claim, but indicated that the claim would be allowable if rewritten in independent form.

Claim 79 is claim 74 rewritten in independent form but without the recitation of "substantially absent projections or recesses," which was present in the previous version of claim 1. As discussed with the Examiner, the cited references do not teach or suggest an "exhaust tube being adapted to provide a non-circuitous flow of effluent therethrough," as recited in claim 79. Therefore, the negative limitation of "substantially absent projections or

"recesses" is not needed and the broader form of the claim is allowable. Thus claims 79-83 are allowable.

CONCLUSION

For the foregoing reasons, allowance of the instant application is respectfully requested. Should the Examiner have any questions regarding the above amendments or remarks, the Examiner is requested to telephone Applicant's representative at the number listed below.

Respectfully submitted,

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MARKED UP SPECIFICATION

On the paragraph bridging pages 11-12:

Preferably, exhaust tube 85 is constructed and integrated with the chamber, to provide a laminar flow of effluent through the tube that undergoes little or no turbulence that would otherwise redirect the flow of effluent in directions other than along the longitudinal axial direction of the tube. In a preferred version, the exhaust tube comprises a cylinder having an internal flow surface that is parallel to the direction of the flow of the effluent through the exhaust tube[, and that is]. The exhaust tube may also be substantially absent or free of projections or recesses that alter the effluent flow path or provide a non-laminar flow of effluent. The inner surfaces of the exhaust tube 85 comprise a surface roughness having a Reynolds number of less than about 10. The smooth-finish of the inner surface of the exhaust tube 85, in combination with a vertical orientation of the tube directly beneath the process chamber 25, as shown in Figure 2, provides a more laminar and less turbulent flow of effluent along the flow path. The laminar flow eliminates turbulence of the effluent gas flow stream and reduces the possibility that effluent gas will diffuse back into the process chamber 25. Positioning the exhaust tube 85 further downstream from the exhaust throttle valve 80, as shown in Figure 2, further reduces the possibility of a back flow of effluent gas from entering and contaminating the process chamber 25 because the pressure in the exhaust tube 85 is lower than the pressure in the process chamber. In addition, a laminar flow of effluent allows energizing radiation to be coupled in a high strength in the region immediately adjacent to the inner surface of the exhaust tube 85 to form a higher density of energized effluent gas or plasma. Also, because the effluent flows continually and uniformly past the inner surface of the exhaust tube 85, the deposition of byproducts on the inner surface, which would otherwise accumulate and impede the coupling of the ionizing radiation, make it unnecessary to frequently clean the exhaust tube 85.

MARKED UP CLAIMS FOR S/N 09/055,201

1. (amended five times) A process chamber for processing a substrate in a process gas and reducing emissions of hazardous gas to the environment, the process chamber comprising:

- (a) a support capable of supporting the substrate;
- (b) a gas distributor capable of introducing process gas into the process chamber;
- (c) a gas activator capable of activating the process gas to perform a process in the process chamber thereby forming effluent containing hazardous gas;
- (d) an exhaust tube through which the effluent may be flowed, the exhaust tube being substantially absent projections or recesses that alter the flow direction of a majority of effluent flowing past the projections or recesses away from a general flow direction of the effluent through the exhaust tube; and
- (e) a microwave energy applicator to couple microwaves to the effluent flowing through the exhaust tube to reduce the hazardous gas content of the effluent.

40. (once amended) The apparatus of claim 10 wherein the exhaust tube is substantially absent projections or recesses that alter the flow direction of a majority of effluent flowing past the projections or recesses away from a general flow direction of the effluent through the exhaust tube.

47. (once amended) The apparatus of claim 46 wherein the sapphire comprises monocrystalline sapphire.

50. (once amended) The process chamber of claim 11 wherein the exhaust tube is substantially absent projections or recesses that alter the flow direction of a majority of effluent flowing past the projections or recesses away from a general flow direction of the effluent through the exhaust tube.

56. (once amended) The process chamber of claim 24 wherein the exhaust tube is substantially absent projections or recesses that alter the flow direction of a majority of effluent flowing past the projections or recesses away from a general flow direction of the effluent through the exhaust tube.

66. (once amended) The process chamber of claim 26 wherein the exhaust tube is substantially absent projections or recesses that alter the flow direction of a majority of effluent flowing past the projections or recesses away from a general flow direction of the effluent through the exhaust tube.

Claims 79-83 are being added.